Annual Project Summary

Paleoearthquake study of the Olinghouse fault zone near Reno, Nevada

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Investigations undertaken

The Olinghouse fault is an active, northeast-trending left-lateral strike-slip fault located within the Walker Lane, a belt of persistent late Cenozoic deformation extending over 700km from the Mojave to the southern Cascades **(Figure 1a)** (Sanders and Slemmons, 1979; Stewart, 1988; Bonham and Slemmons, 1968; Grose, 1993; Pezzopane and Weldon, 1993). Recent GPS geodetic measurements indicate that 6±2 mm/year of northwest-directed, right-lateral shear, or 10-15% of relative Pacific-North America plate motion, occurs across a narrow zone directly east of the Sierra Nevada (Thatcher et al., 1999; Bennett et al., 1998, 1999; Dixon et al., 2000) at the latitude corresponding to the northernmost Walker Lane and the Olinghouse fault. The Olinghouse fault is among the most active of a complex assemblage of northeast-trending left-lateral strike slip faults, north-trending normal faults, and northwest-trending right-lateral strike-slip faults which accommodate shear across the northern Walker Lane **(Figure 1b)**.

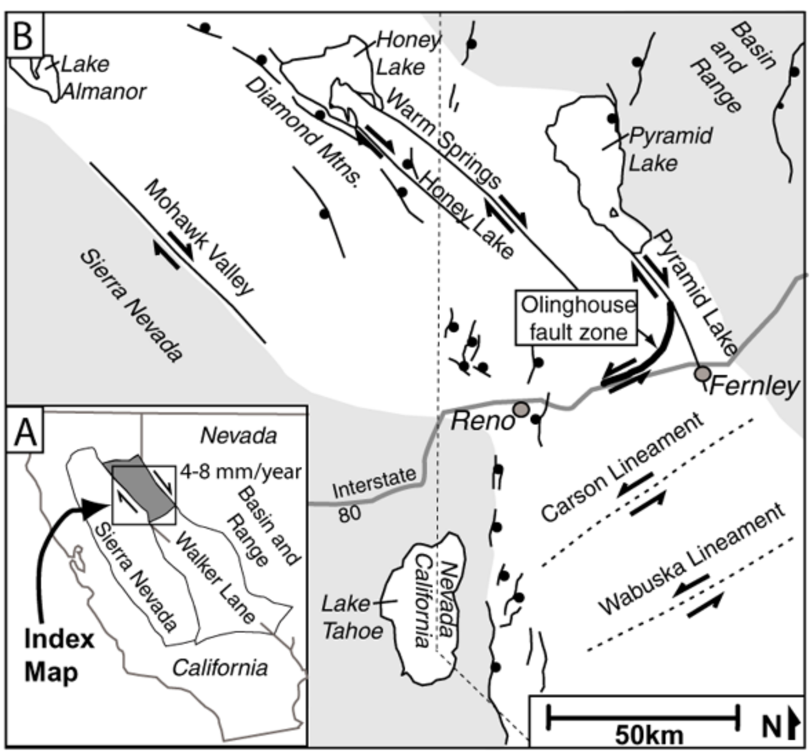

Figure1. (A) Location of the northern Walker Lane (dark shading). Geodetic studies show 4-8 mm/year of NW-directed, right-lateral shear occurs across the dark shaded area. (B) Location of the Olinghouse fault zone.

The paleoseismic history of the Olinghouse fault remains poorly understood, despite geomorphic evidence of Holocene activity (Sanders and Slemmons, 1996), the location of the fault in the actively deforming northern Walker Lane, and the proximity of the fault to the urban area of Reno. Richard Briggs, a Ph.D. graduate student, and I commenced a 1-year project on May 1, 2002 to map and conduct paleoseismic trenching studies along the Olinghouse fault to document earthquake recurrence and recency. Our results will provide a better understanding of the role of the Olinghouse fault zone in accommodating shear within the northern Walker Lane and will improve seismic hazard analyses for northern Nevada and northeastern California.

Preliminary results

We currently have open and are examining five trench exposures across the fault, divided among three study sites (**Figure 2**), to place age constraints on individual paleoearthquakes on the Olinghouse fault zone. We have obtained radiocarbon ages for faulted deposits in one of the trenches (**Figure 3**) and our initial interpretation is that the trench exposures record evidence for at least two earthquakes in the last 3,600 years.

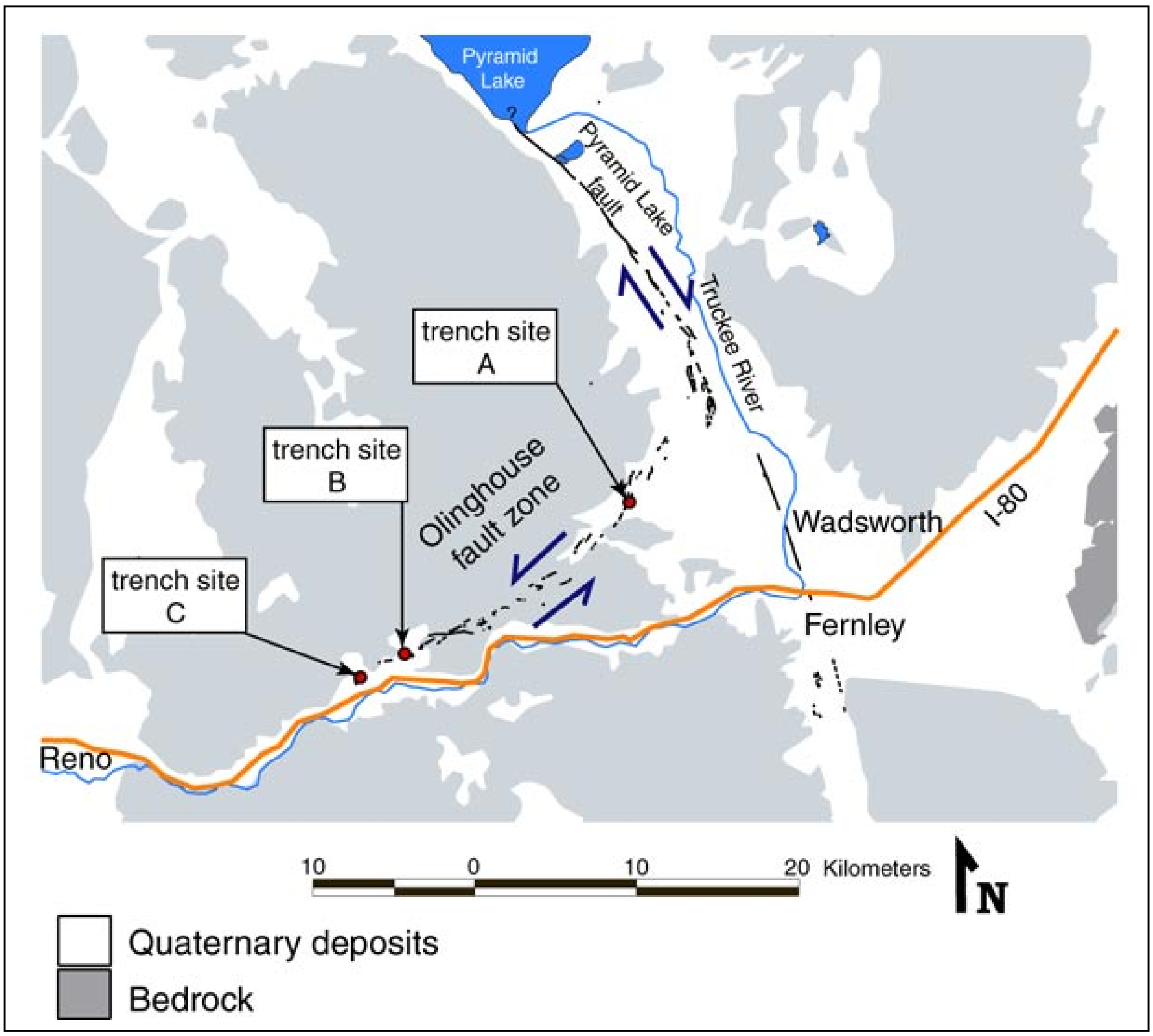

Figure 2. Location of trench sites along the Olinghouse fault zone. The Olinghouse fault strikes toward, and is 15 km from, the urban area of Reno, Nevada.

Trench site A

We placed a trench across a well-defined, continuous, 0.6m (vertical separation) east-facing scarp in young alluvium along the N40E trending segment of the Olinghouse fault, 10km NW of Wadsworth, Nevada **(Figure 2).**

Sediments exposed in the trench comprise two primary facies, a channel gravel facies and a debris flow facies (**Figure 3**). The occurence of these deposits is consistent with the medial-fan location of the trench. Distinctive units are recognized on the basis of bounding unconformities and relative abundance of debris flow or channel gravel sediments. Mapped units are continuous across, and displaced by, the fault and their relative offset records discrete faulting events.

Clear stratigraphic and structural evidence for multiple slip events is exposed in the trench **(Figure 3)**. We interpret two events, a penultimate and most recent event. The penultimate event is associated with colluvium and muddy fill **(unit 5c)** capping sheared material of the eastern, better-developed fault strand. Units below this colluvium and muddy fill are offset a uniform amount. Following the penultimate event, stratigraphically highest units were partially stripped, then overlain by sediments which were then faulted in the most recent event. Units faulted in the most recent event are offset a uniformly lesser amount than those faulted by both events. Apparent thrusting of some of the uppermost units and facies mismatches across the deeper portions of the fault reflect strike-slip motion. Throughout the exposure, fault strands extend nearly to the surface, where they are capped by a thin silty vesicular (Av soil horizon) cap. The total normal component of displacement in the trench closely approximates the vertical separation seen at the ground surface.

We have collected both tephra and detrital charcoal from the exposure **(Figure 3)**. Based on its clean and voluminous character and regular occurrence throughout the area, we have tentatively interpreted the tephra as Mazama in age (7627 +/- 150 cal. ybp; Zdanowicz et al., 1999) The maximum age of the twice-faulted deposits of **unit 3** is given by detrital charcoal sample C-1, which was obtained from the muddy, non-bioturbated matrix of a debris flow layer, and is 3,400±190 cal. years old **(Figure 3)**. Thus the exposure records two events in the last 3,400±190 years. Two samples of detrital carbon obtained from colluvium deposited in a depression along the scarp after the penultimate event **(unit 4c)** show that the colluvium contains reworked older (sample C-4; 4130±170 cal. ybp) and younger (sample C-2; 3090±190 cal. ybp) material.

Trench sites B, C

We have excavated four more trenches at two sites on the western end of the Olinghouse fault zone (Figure 2). Analysis of these trenches is in progress.

Non-technical summary

The Olinghouse fault zone is an active strike-slip fault near Reno, Nevada. We are mapping the active fault trace and have excavated five trenches across the fault to better understand the earthquake history and tectonic activity of the Olinghouse fault zone. Our trenches identify at least two earthquakes in the last 3,400±190 years, a significantly higher rate of paleoearthquake activity than previously identified.

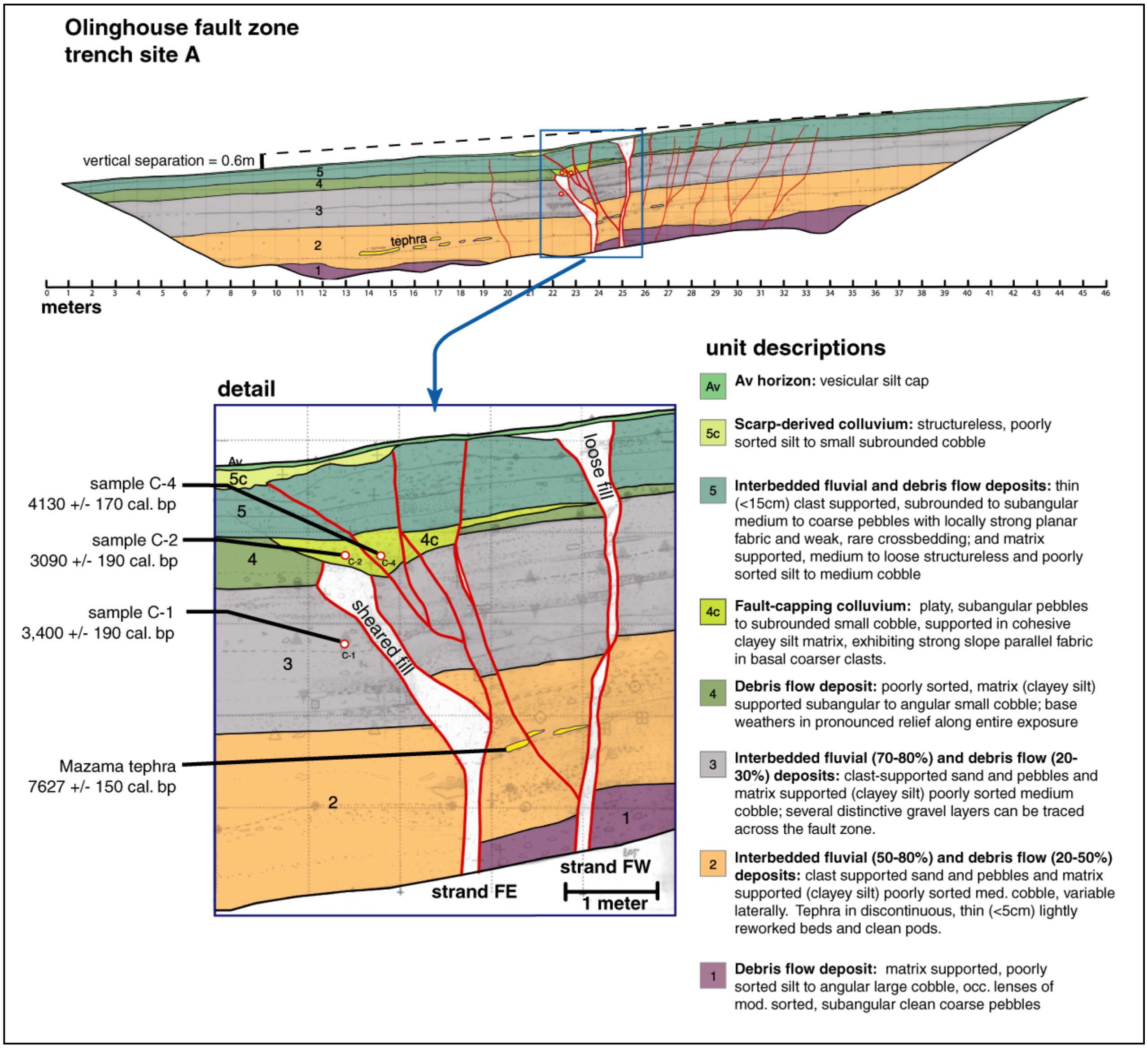

Figure 3. Trench log for trench at site A (see Figure 2 for location).

Reports published

This work has resulted in four abstracts, and results are being written up for submission to a peer-reviewed journal:

Briggs, R.W. and S.G Wesnousky, 2002. Slip Rate and Holocene earthquake recurrence, Pyramid Lake and Olinghouse fault zones, Western Nevada, USA. Invited talk at AEG-AIPG joint meeting, September 23 — 29, 2002.

Briggs, R.W. and S.G. Wesnousky, 2001. Paleoseismic evidence for repeated earthquakes on the Olinghouse fault zone, Western Nevada, USA. EOS Trans. AGU, vol.. 82 no. 47, 2001.

Briggs, R.W, Wesnousky, S.G., and G. Blewitt, 2000, A Geologic and Geodetic Investigation of the Pyramid Lake and Olinghouse Fault Zones, Northern Walker Lane, Nevada: EOS Vol. 81, No. 48, November 28, 2000.

Briggs, R.W., Wesnousky, S.G., and G. Blewitt, 2000, A Reinvestigation of the Pyramid Lake and Olinghouse Fault Zones of the Northern Walker Lane: Geology and Geodesy: Geological Society of America, Annual Meeting, Abstracts with Programs, 2000.

References

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Dixon, T.H, M. Miller, F. Farina, H. Wang, and D Johnson, 2000. Present-day motion of the Sierra Nevada block and some tectonic implications for the Basin and Range province, North American Cordillera. Tectonics 19:1, pp. 1-24.

Grose, T.L.T., 1993. The Walker Lane Belt in northeastern California. Abstracts with Programs - Geological Society of America, vol.25, no.5, pp.44-45.

Pezzopane, S. K. and R.J. Weldon, 1993. Tectonic role of active faulting in central Oregon. Tectonics, 12, 1140-1169.

Sanders, C.O. and D.B Slemmons, 1979. Recent Crustal Movements in the Central Sierra Nevada - Walker lane Region of California-Nevada: Part III, The Olinghouse Fault Zone. Tectonophysics, vol. 52, pp. 585 - 597.

Sanders, C.O. and D.B. Slemmons, 1996. Geomorphic evidence for Holocene Earthquakes in the Olinghouse Fault Zone, Western Nevada. Bull. Seis. Soc. America, vol. 86, no. 6, pp. 1784 - 1792

Stewart, J.H., 1988. Tectonics of the Walker Lane Belt, western Great Basin; Mesozoic and Cenozoic deformation in a zone of shear; in Metamorphism and crustal evolution of hte Western United States, Rubey Volume, vol. 7, pp. 683 - 713.

Thatcher, W., G.R. Foulger, B.R. Julian, J. Svarc, E. Quilty, and G.W. Bawden, 1999. Present-Day Deformation Across the Basin and Range Province, Western United States. Science, Vol. 283.

Zdanowicz, C.M., Zielinski, G.A., and M.S. Germani, 1999. Mount Mazama eruption: Calendrical age confirmed and atmospheric impact assessed. Geology, v. 27, no. 7; pp. 621 - 624.